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# ORTHOGONAL MULTICARRIER MODULATION WITH THE USE OF HARTLEY'S TRANSFORM

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**The paper is devoted to the application of Hartley's transform when information is transmitted with the aid of orthogonal multicarrier modulation. This approach is shown to have a number of advantages in comparison to the ordinary Fourier transform, particularly, a possibility for diminishing the computational and hardware expenditures due to computation based only on real-valued arithmetic. It also permits us to employ identical algorithms both for the receiving and transmitting paths. The results obtained may find application in the design of radio-relay and satellite communication channels, and when using advanced network standards such as HiperLAN/2 and IEEE02.11a.**

The orthogonal multicarrier modulation (OMM or OFDM — Orthogonal Frequency Division Multiplexing) has found wide application in data transmission in modern communication systems due to the possibility of separate processing of signals with the use of a large number of carriers which are orthogonal to one another [1, 2]. The use of OMM provides a way for transmission of information flows with high speed over radio channels in radio-relay and satellite communication systems.

OMM was first suggested in [3, 4] and described in detail in [5, 7]. The principle of OMM consists in frequency separation of channels with orthogonal carrier frequencies. The key element of OMM is the backward Fourier transform (BFT) in the transmission path and forward Fourier transform (here — FT) in the reception one [3–7].

If an input signal is represented as a discrete complex-valued sequence of data $c_n$, then BFT over the formed complex signals has the form

$$s(t) = (1/T_S)\sum_{n=0}^{N-1} c_n \exp(\mathrm{j}2\pi f_n t) \tag{1}$$

where $c_n = \sum_i d_n(i)g(t - iT_s)$ are the amplitude-phase code symbols of the $m$-position ($m = 2, 4, 8, 16,...$) system of the digital phase (DPM) or digital amplitude-phase (DAPM) modulation [8], $g(t) = \mathrm{rect}\,(t/T_s)$ corresponds to rectangular shape of transmission of symbols of duration $T_s$, and $f_n = n\Delta f = n/T_s$ is the frequency corresponding to the transmission channel with its index $n$, $iT_s \le t \le (i+1)T_s$.

The signal $s(t)$ in (1) is equivalent to the signal with separation in frequencies $f_n$ and with the phase or amplitude-phase keying in every channel. In the reception path, on each time interval $[iT_s, (i+1)T_s]$, the signal is restored with the aid of FT:

$$\hat{c}_n = \int_{iT_S}^{(i+1)T_S} r(t)\exp(-\mathrm{j}2\pi f_n t)\,\mathrm{d}t \tag{2}$$

where $r(t) = s(t) * h_c + \xi(t)$ is the convolution of the input signal with the pulse response of the communication channel plus the additive white noise.

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